

# Biodiesel

For the Global Environment

## Biodiesel—the Clean, Green Fuel for Diesel Engines

### What is biodiesel?

Natural, renewable resources such as vegetable oils and recycled restaurant greases can be chemically transformed into clean-burning biodiesel fuels. As its name implies, biodiesel is like diesel fuel except that it's organically produced. It's also safe for the environment, biodegradable, and produces significantly less air pollution than diesel fuel. It even smells better than diesel fuel—it smells like french fries, donuts, or barbecue.

### Can I use biodiesel in my vehicle, generator, or boat?

You can use 100% pure biodiesel where you use diesel fuel, except during cold weather. During cold weather

biodiesel thickens more than diesel fuel and special systems are required. Equipment made before 1993 may have rubber seals in fuel pumps and fuel systems that could fail if 100% biodiesel is used. You should replace these seals with Viton™ or other non-rubber seals if you use 100% biodiesel. You can use a blend of 20% or 35% biodiesel with any diesel fuel even in old engines with no changes. Just keep an eye on those seals. There are fewer cold weather problems with blends, but you still need to be aware they could occur. Biodiesel mixes well with diesel fuel and stays blended even in the presence of water.

### What will biodiesel do to my fuel economy and power?

Pure biodiesel will reduce your fuel economy and power by 10%. In other words, you'll need 1.1 gallons of biodiesel for every 1 gallon of diesel fuel displaced. A 20% blend of biodiesel with diesel fuel (B20) should show a 2% reduction on average, but we see no change most of the time.

Diesel fuel blends with biodiesel have superior lubricity, which reduces wear and tear on your engine and make the engine components last longer. Biodiesel blends will also clean your fuel system, so keep a couple of spare fuel filters handy during the first few weeks after you switch fuels.

### Is biodiesel safe?

Yes! Biodiesel is made from cooking oils and alcohol, so if you spill it on the ground, it will quickly degrade into natural organic residues. We don't recommend you drink it,

however. After all, you probably wouldn't want to drink a cup of cooking oil, because it will "lubricate" your digestive tract. Biodiesel is as toxic as table salt, and safe to handle. Mechanics who use biodiesel notice that their hands don't crack and dry out the way they do with diesel fuel. Many people use biodiesel in marine environments to protect wildlife and hatcheries.



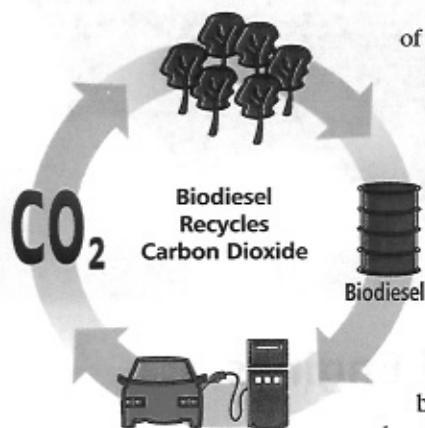
### Does biodiesel reduce air pollution?

Very much so. Biodiesel reduces nearly all forms of air pollution. Most importantly, biodiesel reduces air toxics and cancer-causing compounds. Pure biodiesel can reduce the cancer risks by 94%; B20 will reduce that risk by as much as 27%. There is no sulfur in biodiesel, so biodiesel won't contribute to sulfur dioxide emissions or poison exhaust catalysts. B20 has 20% of the benefits of pure biodiesel. B20 can also reduce the soot and smell of diesel exhaust.

Emission	B100	B20
Carbon monoxide	-43.2%	-12.6%
Hydrocarbons	-56.3%	-11.0%
Particulates	-55.4%	-18.0%
Nitrous oxides	+5.8%	+1.2%
Air toxics	-60%–90%	-12%–20%
Mutagenicity	-80%–90%	-20%

### Does biodiesel reduce greenhouse gases?

Yes. Each year, soybeans and other plants that produce oils used for cooking or making biodiesel draw CO<sub>2</sub> from the atmosphere to build stems, leaves, seeds (which contain the oil), and roots. At the end of the year, the oil used for biodiesel is burned and the leftover plant material decomposes, returning the carbon from the fuel and plant matter to the atmosphere as carbon dioxide (CO<sub>2</sub>). This recycling of carbon from CO<sub>2</sub> in the atmosphere to carbon in plant material and back to the atmosphere results in no accumulation



of CO<sub>2</sub> in the atmosphere. Therefore, it does not contribute to global climate change. Carbon dioxide from the petroleum fuels used for fertilizer, farm equipment, or transportation during biodiesel production accumulates in the atmosphere year after year. As a result, biodiesel produces 78% less CO<sub>2</sub> than diesel fuel.

Biodiesel produces 2661 grams of CO<sub>2</sub> per gallon, compared to 12,360 grams per gallon for petroleum diesel fuel.

### Where can I buy biodiesel or biodiesel blends?

The biodiesel industry is small, but growing quickly. There are seven producers in the United States today. Most biodiesel is now sold as B20 to bulk (large) customers such as school bus fleets. Any local petroleum distribution company or biodiesel producer can deliver B20 to bulk customers. Most communities do not yet have biodiesel fuels available, but we know that many of you would like to buy it at your local retail station, so keep asking and maybe you can make that a reality.

### Why aren't more people using biodiesel?

Biodiesel is very new and, unfortunately, it is slow catching on because it is expensive. Biodiesel sells for \$1.50–\$2.25 per gallon wholesale (pre-tax); fuel taxes add another \$0.50 per gallon. That's why people prefer B20; it's less expensive. The U.S. Department of Energy is working with the biodiesel industry to reduce the cost of biodiesel to less than \$1 per gallon over the next 5 years. The U.S. Environmental Protection Agency will soon require refineries to make cleaner (more expensive!) petroleum diesel fuel, so over time, the cost difference between these two fuels will be reduced.

### Are there biodiesel fuel standards?

Yes. You need to make sure the biodiesel you use meets ASTM PS 121. The producer can provide that information. You can inspect the fuel yourself if it isn't already blended with diesel fuel. Make sure there is no water, sediment, or thick viscous layers on the bottom. If you suspect any problems, send a sample to a laboratory for testing. The National Biodiesel Board can recommend an appropriate laboratory.

### What is biodiesel made of?

Biodiesel can be made from many oils and fats such as soy, canola, tallow, mustard, and restaurant greases. DOE does not recognize any blanket claims of one feedstock's superiority over others, since feedstocks do not reliably predict a fuel's final properties. Customers should base their specifications on the fuel's (or blended fuel's) properties. (This statement has been revised from a previous printing in April 2000.)

### How long can I store biodiesel?

About the same length of time as diesel fuel in most cases. We don't recommend storing biodiesel longer than 6 months without storage additives.

Fuel Property	Diesel	Biodiesel
Fuel Standard	ASTM D975	ASTM PS121
Fuel Composition	C10-C21 HC	C12-C22 FAME
Lower Heating Value, Btu/lb	130,250	120,910
Kin. Viscosity, @ 40°C	1.3–4.1	1.9–6.0
Specific Gravity kg/l @ 60°F	0.85	0.88
Density, lb/gal @ 15°C	7.079	7.328
Water, ppm by wt.	161	.05% max
Carbon, wt. %	87	77
Hydrogen, wt. %	13	12
Oxygen, by dif. wt. %	0	11
Sulfur, wt. %	.05 max	0
Boiling Point °C	188 to 343	182 to 338
Flash Point °C	60 to 80	100 to 170
Cloud Point °C	-15 to 5	-3 to 12
Pour Point °C	-35 to -15	-15 to 16
Cetane Number	40 to 55	48 to 60
Autoignition Temperature °C	316	
Stoichiometric Air/Fuel Ratio, wt./wt.	15	13.8
BOCLE Scuff, grams	3,600	>7,000
HFRR, microns	685	314

For more information about biodiesel and ongoing research, contact:

Mike Voorhies, U.S. Department of Energy  
Office of Fuels Development  
202-586-1480

K. Shaine Tyson, National Renewable Energy Laboratory,  
Renewable Diesel Project, 303-275-4616, or  
k\_shaine\_tyson@nrel.gov



Produced for the U.S. Department of Energy (DOE) by the National Renewable Energy Laboratory, a DOE national laboratory.

DOE/GO-102000-1048  
May 2000



Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 20% postconsumer waste.